

What is claimed is:

1. A semiconductor memory device comprising:
a substrate;
a MOS (metal oxide semiconductor)
transistor formed in a surface portion of said
5 substrate, wherein said MOS transistor includes a
source, a gate, and a drain;
a first inter-level dielectric covering
said MOS transistor;
a capacitor element including:
10 a bottom electrode,
a dielectric layer formed on said bottom
electrode, and
an upper electrode formed on said
dielectric layer;
15 a first contact formed through said first
inter-level dielectric to electrically connect
said bottom electrode to said source, wherein
said first contact includes a first metal portion
formed of metal.
2. The semiconductor memory device according
to claim 1, wherein said metal is refractory
metal, and said first contact further includes a
barrier layer formed between said source and said
5 first metal portion.

3. The semiconductor memory device according to claim 2, wherein said refractory metal is tungsten, and said contact barrier layer is formed of titanium nitride.

4. The semiconductor memory device according to claim 3, wherein said bottom electrode includes:

5 a polysilicon layer connected to said dielectric layer, and

an electrode barrier layer formed between said first metal portion and said polysilicon layer.

5. The semiconductor memory device according to claim 4, wherein said electrode barrier layer is formed of titanium nitride.

6. The semiconductor memory device according to claim 1, further comprising:

5 a second contact formed through said first inter-level dielectric to be connected to said drain, wherein said second contact includes a second metal portion formed of said metal.

7. The semiconductor memory device according to claim 6, wherein said metal is tungsten, and

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said second contact further includes a second
barrier layer formed of titanium nitride between
5 said drain and said second metal portion.

8. The semiconductor memory device according
to claim 6, further comprising:

a second inter-level dielectric covering
said capacitor element and said first inter-level
5 dielectric;

a third contact formed through said second
inter-level dielectric; and

a bit line formed on said second inter-
level dielectric, wherein said second and third
10 contact electrically connect said drain to said
bit line.

9. The semiconductor memory device according
to claim 8, further comprising:

another MOS transistor provided in a
surface portion of said substrate for a
5 peripheral circuit;

a fourth contact formed through said first
inter-level dielectric to be connected to said
another MOS transistor on a source/drain thereof;

a fifth contact formed through said second
10 inter-level dielectric to be connected to said
fourth contact, wherein said fourth contact

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includes a third metal portion formed of said metal.

10. The semiconductor memory device according to claim 1, wherein said bottom electrode comprises:

a polysilicon layer connected to said
5 dielectric layer, and

an electrode barrier layer formed between said first metal portion and said polysilicon layer.

11. The semiconductor memory device according to claim 10, wherein said electrode barrier layer is formed of titanium nitride.

12. The semiconductor memory device according to claim 10, further comprising a second inter-level dielectric covering said first inter-level dielectric, wherein a hole is formed through said
5 second inter-level dielectric, and

wherein said electrode barrier layer includes:

a bottom barrier portion formed on said metal portion of said first contact, and

10 a side barrier portion connected to said bottom barrier portion, said side barrier portion

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being formed on a side surface of said hole to extend towards an upper surface of said second inter-level dielectric, and wherein

15 said polysilicon layer includes:

a bottom electrode portion formed on said bottom barrier portion, and

a side electrode portion connected to said
bottom electrode portion, said side electrode

20 portion being formed on said side barrier portion,
and

wherein an end of said side electrode portion is substantially in alignment with said upper surface of said second inter-level

25 dielectric, while an end of said side barrier
portion is out of alignment with said upper
surface of said second inter-level dielectric,
said side barrier portion not reaching said upper
surface of said second inter-level dielectric.

13. A method of fabricating a semiconductor memory device comprising:

providing a substrate;

forming a MOS transistor in a surface
5 portion of said substrate, wherein said MOS
transistor includes a gate, a source, and a
drain;

forming a first inter-level dielectric to

cover said MOS transistor;

10 forming a first contact through said first
inter-level dielectric such that said first
contact is connected to said source of said MOS
transistor, wherein said first contact includes a
first metal portion formed of metal;

15 forming a bottom electrode connected to
said first contact;

forming a dielectric layer formed on said
bottom electrode;

forming an upper electrode formed on said
20 dielectric layer.

14. The method according to claim 13, wherein
said metal of said first metal portion is
refractory metal, and said first contact further
includes a first contact barrier layer formed
5 between said source and said first metal portion.

15. The method according to claim 14, wherein
said refractory metal is tungsten, and said
contact barrier layer is formed of titanium
nitride.

16. The method according to claim 13, wherein
said bottom electrode includes:

a polysilicon layer connected to said

dielectric layer, and

5 an electrode barrier layer formed between
said first metal portion and said polysilicon
layer.

17. The method according to claim 16, wherein
said metal is tungsten and said electrode barrier
layer is formed of titanium nitride.

18. The method according to claim 13, further
comprising:

 forming a second inter-level dielectric to
cover said first inter-level dielectric and said

5 first contact;

 forming a hole through said second inter-
level dielectric to expose said first contact,

 wherein said forming said bottom electrode
includes:

10 depositing a conductive barrier material
film on a side surface and bottom surface of said
hole,

 depositing a polysilicon film on said
conductive barrier material film,

15 concurrently removing outside portions of
said conductive barrier material film and said
polysilicon film outside said hole to form said
electrode barrier layer and said polysilicon

layer, and

20 selectively etching an end portion of said
electrode barrier layer in the vicinity of an
upper surface of said second inter-level
dielectric such that an end of said conductive
barrier material film does not reach said upper
25 surface of said second inter-level dielectric,
while said polysilicon layer is not etched.

19. The method according to claim 18, further
comprising:

 forming a resist layer on said polysilicon
film to plug said hole after said depositing said
5 polysilicon film, wherein said layer is used as a
mask for said concurrently etching; and

 removing said resist layer by a plasma
process in an atmosphere including fluorocarbon,
wherein said selectively etching is concurrently
10 achieved during said removing said resist layer.

20. The method according to claim 13, further
comprising:

 forming an etching stopper layer to cover
said first contact and said first inter-level
5 dielectric;

 forming a second inter-level dielectric on
said etching stopper layer;

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10 wherein said etching said second inter-level
dielectric is stopped by said etching stopper
layer;

15 second inter-level dielectric and said etching
stopper layer, wherein said bottom electrode,
said dielectric layer, and said upper electrode
are disposed inside said hole.

5 to said drain, said second contact including a
second metal portion formed of said metal,
wherein said first and second contacts are
concurrently formed; and

10 is electrically connected to said drain through
said second contact.

forming another MOS transistor in a surface

portion of said substrate for a peripheral
5 circuit;

forming a third contact formed through said first inter-level dielectric to be connected to a source/drain region of said another MOS transistor, said third contact including a third metal portion formed of said metal, wherein said first, second and third contacts are concurrently formed; and

forming an interconnection, wherein said
interconnection is electrically connected to said
15 source/drain region through said third contact.